



RING MAIN UNIT

SUSTAINABLE | DIGITAL | FUTURE-READY



L&T Electrical & Automation

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INTRODUCTION

L&T Electrical & Automation (E&A)'s FR range of Ring Main units are compact, modular and extendable SF6 Gas Insulated switchgears with Vacuum interrupter based circuit breaker. Ring Main Unit provides safe, reliable and future-ready solution for the switching operations in secondary distribution network with minimum maintenance.

L&T Electrical & Automation (E&A) designs, manufactures and markets a wide range of low voltage and medium voltage electrical systems, control and automation systems, electrical products and metering and protection systems. Our core strength in engineering and MV product development, bolstered by strong R&D, enables us to deliver the most comprehensive, best-in-class electrical solutions to our diverse customer base.

APPLICATIONS



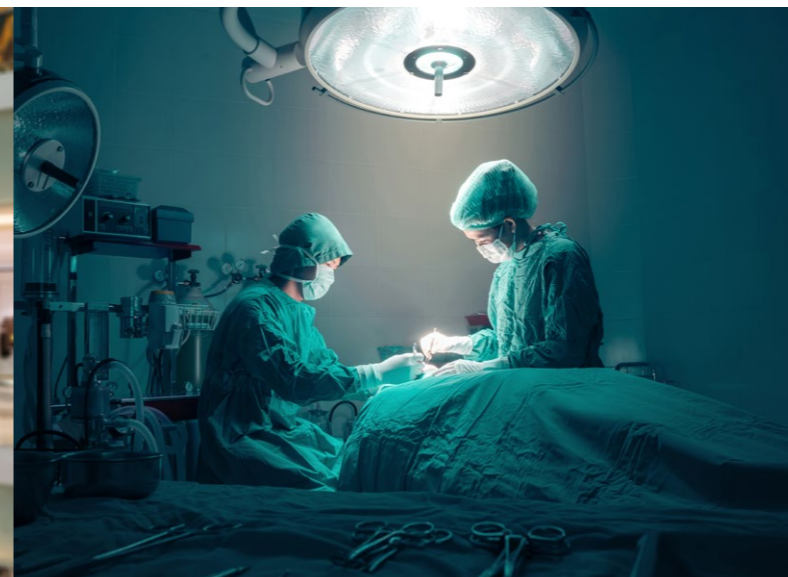
Utilities and Power Plants

- Smart city networks
- Secondary distribution
- Underground cabling projects
- Industries
- Wind and solar power plants



Transport

- Airports
- Ports
- Railways



Infrastructure

- Supermarkets
- Shopping malls
- Hospitals
- Residential infrastructure

RMU CHARACTERISTICS

- Up to 17.5kV, 21kA, 630Amps ratings.
- Modular – with extensibility, motorisation and SCADA compatibility options
- Switching functions enclosed in a SF6 gas insulated steel tank, sealed for life
- Intuitive single line mimic diagram for simple and safe operation
- Integrated earth and test facility for easy and safe cable test without removing cable connections.
- Anti-reflex mechanism to prevent load break switch opening under fault conditions
- Fully interlocked operation with padlocking facility for maximum operator's safety.
- Freestanding units.
- Actuators (motorized) for ring switches and circuit breakers
- Seamless integration with SCADA network for remote operation and control
- Maintenance free with 30 years life expectancy.
- **Applicable standards**
 - IEC-standards:
 - IEC 62271-1: Specifications High-voltage switchgear
 - IEC 62271-100: Alternating-current circuit-breakers
 - IEC 62271-102: Alternating current disconnectors earthing switches
 - IEC 62271-103: High-voltage switches
 - IEC 62271-200: Arc fault and switchgear
 - IEC 60529: Degrees of protection provided by enclosures
 - FR1 VI is also tested together with CSS according to IEC 62271-202 standard.
- **Normal operating condition**
 - Ambient air temperature
 - Minimum air temperature: -10°C
 - Maximum air temperature: + 50°C
 - Maximum 24 hrs. average < 35°C
- **Air humidity**
 - The average air humidity measured over a period of 24hrs should be upto 95 %.
 - The average air humidity measured over a period of one month should be upto 90%.
- **Installation altitude:** Normally upto 1000m.
- **Solar radiation:** Solar radiation up to a level of 1000W/m2
- **Wind speed:** upto 34m/s.

**For special cases and requirements, please contact the E&A sales personnel nearest to your region.*



SAFETY



- Protection against Arc faults
- No exposure to live parts
- Passive interlocks to prohibit unintended operations
- Comprehensive padlocking facilities
- Mimic diagram and position indicators to guide the operator
- Complete Safety for User and Pedestrian

1. IAF – AF, AFL & AFLR

The successful verification of internal arc classification, IAC A (F,L,R), for our switchgear ensures the highest possible degree of protection to operating personnel and switchgear vicinity. RMU incorporates independent pressure relief mechanisms for SF6 enclosure and Cable compartment. In the unlikely event of an internal arc fault, the gases are expelled at the rear of the cubicle, as far from the operator as possible, for improved safety.



2. Interlocks

RMU comprises a set of complete electrical interlocking in grouping with intelligent & strong mechanical interlocks to prevent any accidental erroneous operation, resulting in a safer environment for both plant and personnel. For maximum safety, all operations are performed from the front, with highly reliable fool-proof interlocks:

A. Cable Compartment Access Interlock: -

The cable box can be duly interlocked with RSW and CB such that cable box can be opened only in EARTH position of RSW and CB. Access to test terminals is achieved by moving the appropriate RSW and CB to EARTH position and opening the interlocked cable compartment cover.



B. Load Break Switch Interlock: -

Three Position load break switches are naturally interlocked for being On and Earth at a time.



C. VCB-DS Interlock: -

Dis-Connecting switch can be operated only when VCB is in OFF condition.



SUSTAINABLE



Unmatched structural integrity

Our RMUs are made of high grade stainless steel & mild sheets, cut and folded on numerically controlled machines, making the enclosure sturdy and reliable.

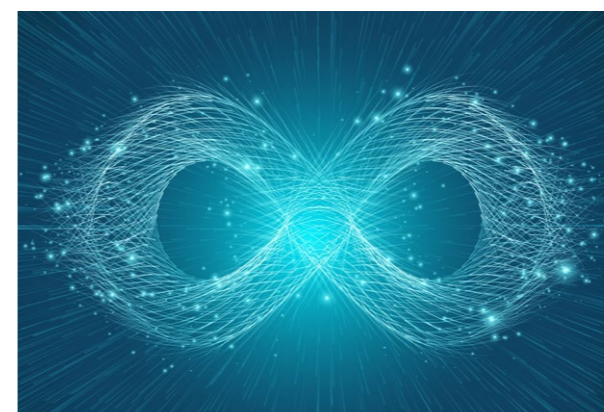


Clean-Room

Highly automated clean room facility for assembling important components of RMU F6 Tank.

Helium Leakage Detection

Fully automated Leakage detection chamber facility for, Helium chamber having capability for checking leak in parts per billion. Leak rate testing up to 1×10^{-8} mbar ltr/Sec



Infinite cycles

Our Vacuum Circuit Breaker require minimal maintenance and have a design life of 20 years or 10,000 mechanical operations.

DIGITAL



Numerical relay

FR1-VI can be delivered with different types of self-powered protection numerical relay for 630A vacuum circuit-breaker. These relays are mounted on front facia of RMU or with additional LV compartment if motorized. These relays are specially designed for ring main unit application. Relays are with following basic functions:

- Relay gets energised either from CT Current, Aux. voltage, front USB or internal battery (whichever is available)
- O/C, S/C, E/F and E/F High set protection
- DEFT and Inverse characteristics for O/C and FJF, individually selected for phase and earth fault
- Unbalance / Asymmetric protection
- Potential pulse output for direct triggering the circuit breaker coil. Potential free alarm contacts also available
- Remote trip & Remote protection block input DI
- RS485 Modbus
- USB port for PC/ Laptop interface.

Relay will operate its trip contact when CT current is present, or aux. supply is available. FR1VI is offered with multiple makes of relays models like CSDPR, ADR141, 7SR45. These relays give flexibility in communication and remote tripping of CBs. Also, it records faults and events. All customer settings can be done on site.



Note : For more details refer individual relay catalogs.

Modular RTU/ FRTU hardware



Looking at the smart secondary distribution network requirement for getting uninterrupted power supply or minimum down time demand, FR1VI can be offered with iLT-ADAM-5630 RTU for controlling and monitoring RMU from central location.

The device includes a central processing module with expandable I/O modules (digital input modules, Analog I/P Modules and digital output modules). The local central processing module handles all protocol, performs data acquisition, and executes control requests. It accepts commands from the master station, performs address recognition, assembles response messages in accordance with the received command messages, and transmit them to the master CPU or SCADA master station(s).

Basic Features:

- Support Modbus/RTU, Modbus TCP/IP, IEC61850 IEC-60870-5-101/104/103 function libraries.
- Support Web server for I/O configuration and monitoring
- Supports cyber security standards
- Supports SNMP
- Supports IEC-61131-3 programming language
- Built-in real-time clock and watchdog timer
- 1 micro SD slot expansion for data storage
- 4 serial communication ports onboard
- 2 Ethernet Ports
- 4 or 8 I/O slot expansion

FUTURE-READY

Maximize your space

RMU is characterized by a reduced width & Depth which offers savings on space and civil costs. Even with configuration of 2LBS+1VCB as slim as 1050mm in Width & 800mm in Depth, along with spacious compartments, allowing easy access for installation and maintenance.



More space. More capability.

The cable termination height is well above floor level, and generous space is provided for terminating power cables. This ensures a higher bending radius and reduces tension on the terminals.



Smart addition

RMU Extension at shopfloor & site for other RMUs or Metering panel is made simple and safe through easily accessible busbar connections and links.



Technical specifications

General Parameters		
Rated Voltage	kV	12 kV
Rated Current	A	630A
Rated Frequency	Hz	50/60Hz
Rated Short Time Current	kA/3sec	21
Rated Short Circuit Making Current	kAp	52.5/54.6
Rated Short Circuit Symmetric Breaking Current	kA	21
Rated Lightning Impulse Voltage (1.2/50 sec)	kVp	75
Power Frequency Withstand Voltage	kV(rms)	28
Internal Arc Fault withstand	kA-1 sec	21
Insulation medium		Sulphur Hexafluoride (SF6)
Rated gas pressure	bar	1.35
Alarm gas pressure	bar	1.25
Loss of service continuity		LSC2
Internal arc classification		AFL (AFLR on request)

Vacuum Circuit Breaker

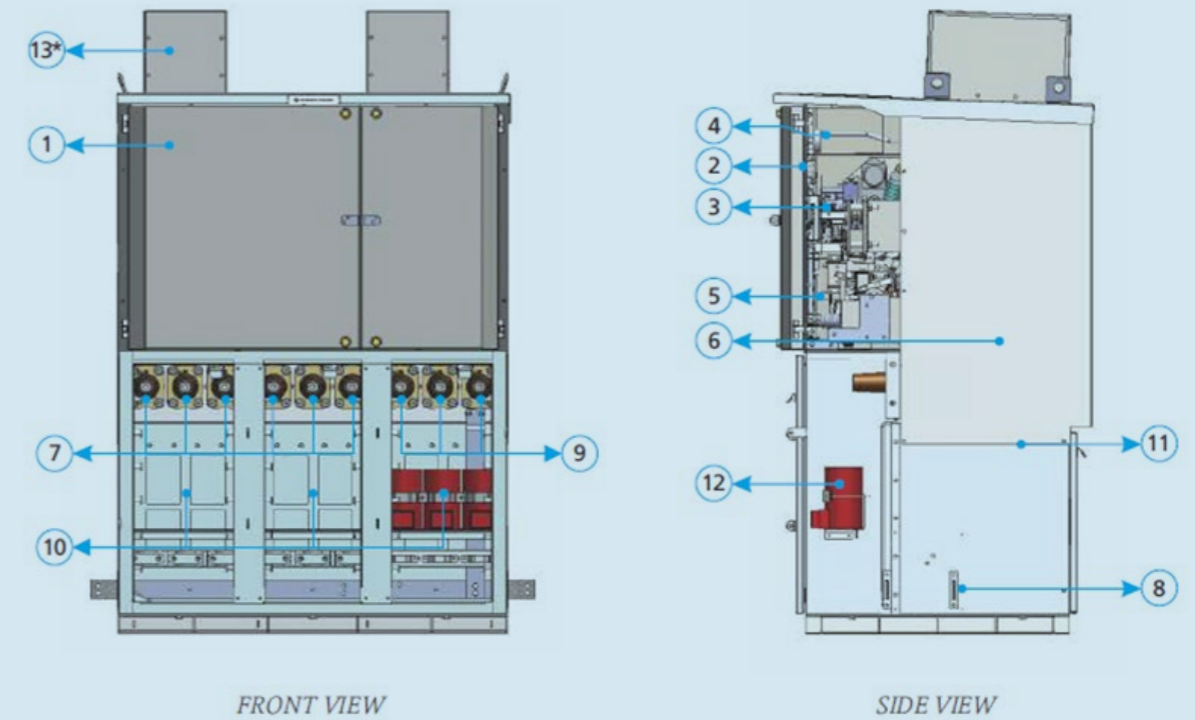
Operating duty	O-0.3s-CO-3 min-CO
Mechanical operation life	10000 operations
Spring motor charging time	< 10 sec

Load Break Switch

Operating method	Motor-spring/ Manual-spring operation
Mechanical operation life	1000 operations



DESIGN & CONSTRUCTION



1. Access door
2. Facia & mimic diagram
3. Circuit breaker operation
4. Gas tank pressure gauge
5. Ring switch operation
6. Sealed SF6 tank
7. Ring switch bushings
8. Earthing point
9. Tee-off bushings
10. Cable box
11. Bursting disc
12. CT arrangement on cable
13. Extensible bushing position (*On request)

Note: Feeder Remote Terminal Unit and Metering Unit are optional.

BASIC DETAILS OF RMU :

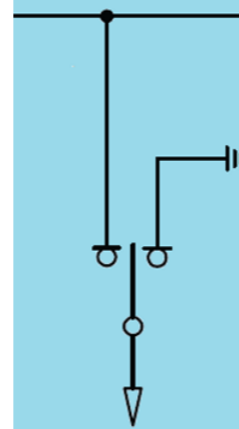
- Ring feeders with three position switch dis-connectors
- Circuit breaker feeder with combined Vacuum interrupter Dis-connector and earthing switch
- Capacitive voltage detection system for all feeders
- Protective self-powered relay & current transformers for transformer protection
- Individual panel / block type construction
- Manual operating mechanism (option: with motor)
- Cable connection from front
- Logical mechanical interlocks
- Gas pressure monitoring via Manometer

OPTIONAL EQUIPMENT

- Busbar extension LHS/RHS
- Motorised Operation
- Metering feature
- Manometer with 2 NC contacts for Alarm & lockout
- SCADA RMU ready with terminals
- Voltage indicating Unit with Phase Comparator
- Fault Passage indicator
- Non-Metallic Cable support clamps/clits
- Extra base frame (Ht=310/450 mm)
- Integrated control and monitoring
- Trip coil open and close
- Earth switch position contact
- Auxiliary switch for VCB-5 NO-NC
- Auxiliary switch for load break switch position 2NO + 2NC
- Field Remote Terminal Unit(FRTU)

LOAD BREAK SWITCH(LBS)

- Three position load break switch with dis-connector and earthing switch
- Common operating mechanism for load break function and earthing function
- Switch position indication for load break switch and earthing switch
- Cable bushings horizontal in front, Interface C with integrated voltage divider for voltage Indication

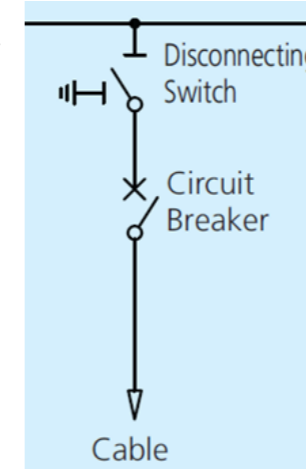


BASIC FEATURES IN LBS

- Bushings for connection of external cable & busbar
- Fault passage indicator for LBS
- Interlocking of cable compartment Door
- Latched single spring mechanism for ring cable switch
- Single/Three Core cables can be easily fitted in standard compartment
- Inbuilt socket for Cable testing at each phase in cable compartment

VACUUM CIRCUIT BREAKER (VCB)

- 400 A vacuum circuit-breaker for transformer protection or 630 A vacuum circuit-breaker for feeder protection
- Two position double spring mechanism for vacuum circuit breaker
- Three positioning single spring mechanism for disconnector/earthing switch
- Cable bushings horizontally in front; Interface C (400 series bolted) for 630 A vacuum circuit-breaker with integrated capacitor for voltage indication
- Switch positioning indication for vacuum circuit-breaker and disconnector/earthing switch



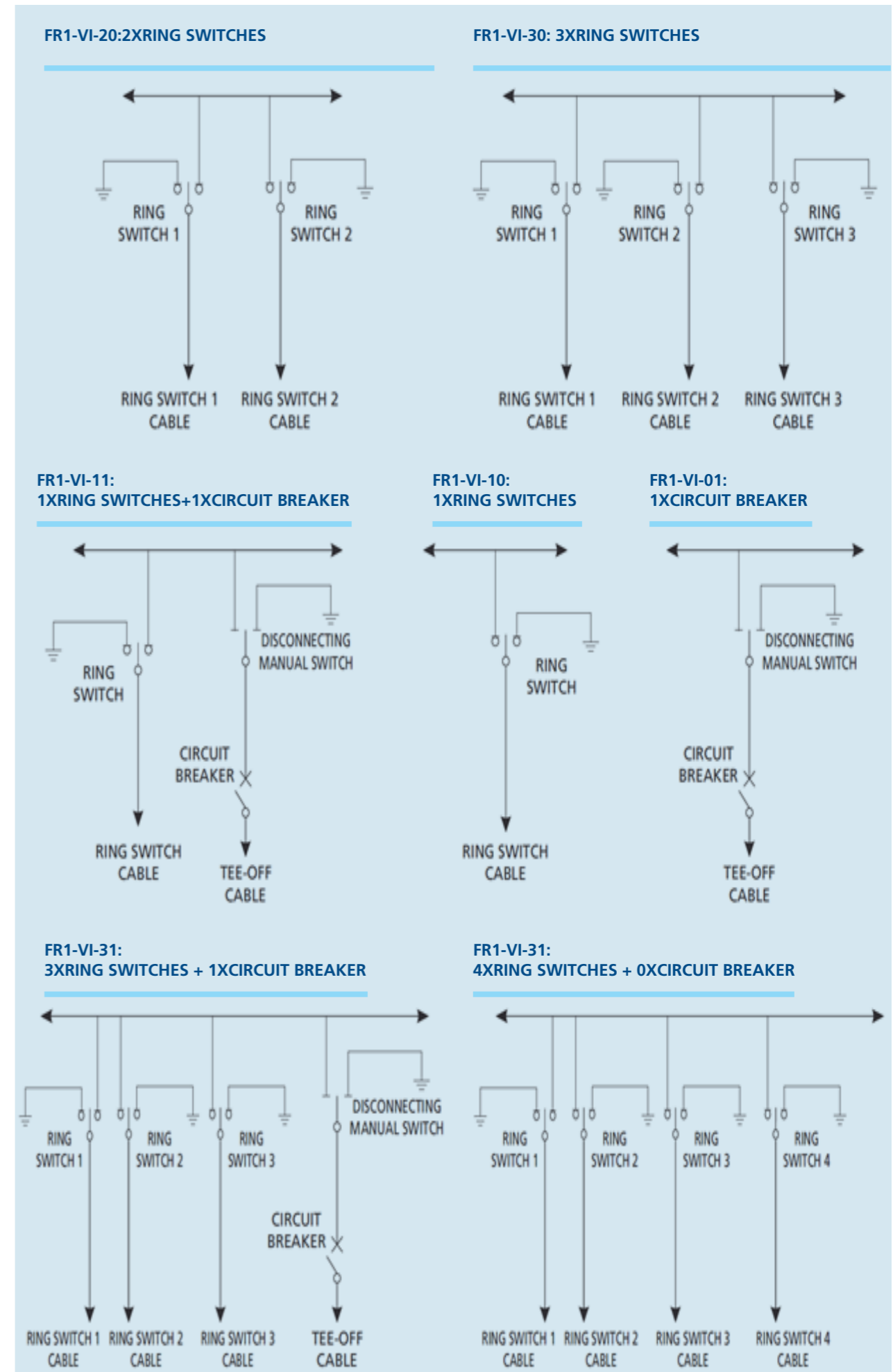
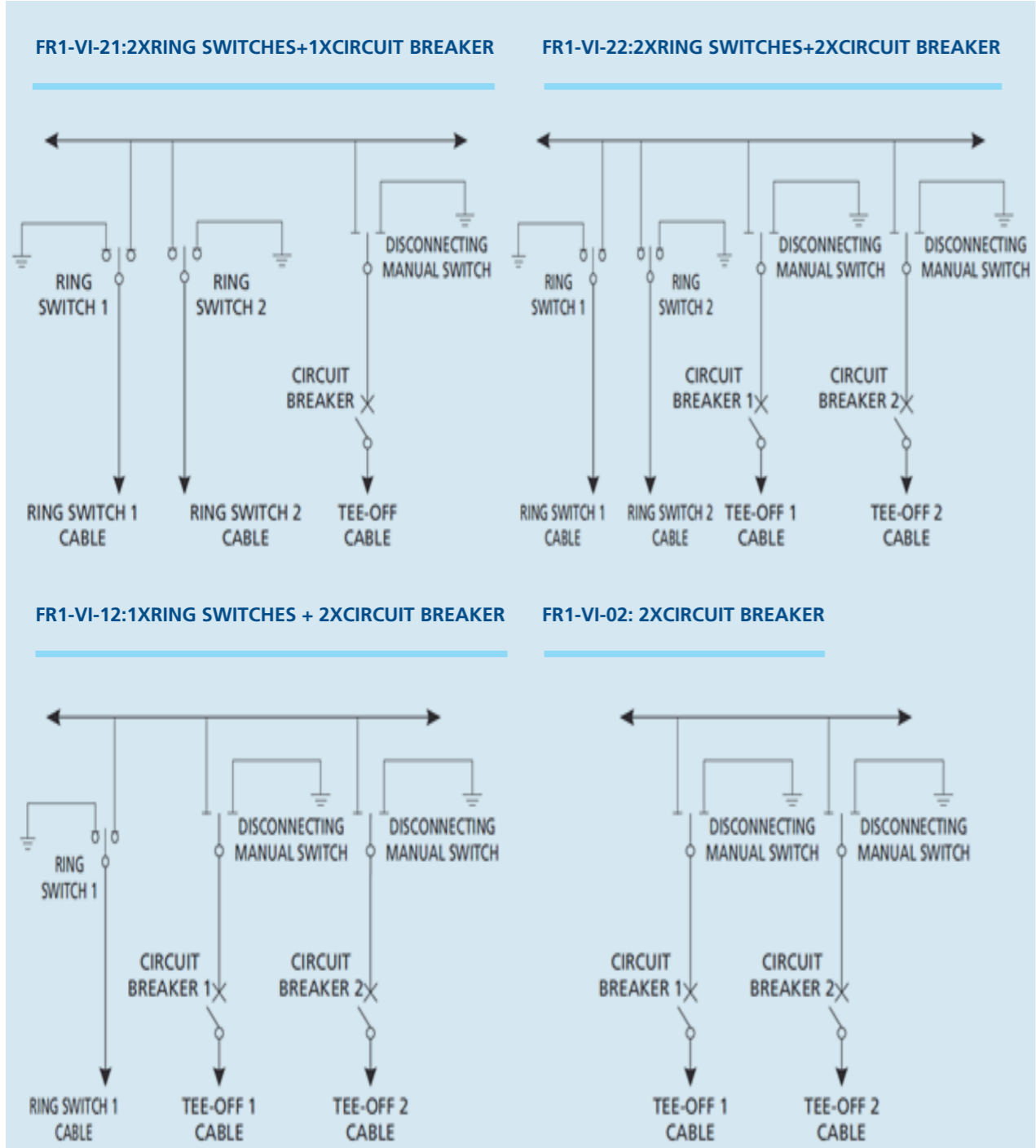
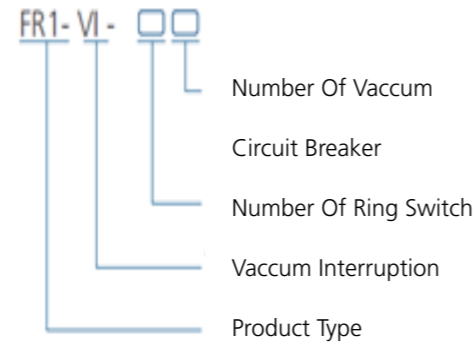
BASIC FEATURES IN VCB

- Interlocking between vacuum circuit-breaker and disconnector/earthing switch
- Self-powered electronic protection relay with ring core CTs on cables
- Bushings for connection of external cable & busbar
- Metering CTs provision
- Interlocking of cable compartment Door
- Single/Three Core cables can be easily fitted in standard compartment
- Inbuilt socket for Cable testing at each phase in cable compartment



FR SERIES RMU VARIANTS & CONFIGURATIONS

Due to the diverse customer applications & requirements, FR series of RMU are available in various configurations based on number of LBS & VCB required. This catalog provides the typical information of standard configurations. For specific configurations users will be provided with a separate ANNEXURE supplement. configurations are available optionally with extensible feature



IMPORTANT FEATURES OFFERING IN RMU



Cable Termination Provision in Cable Compartment:

- Access to the cable compartment only if the feeder has been disconnected and earthed.
- Bushings according to DIN EN 50181 with outside cone and bolted connection M16 as interface type "C".

The Following Cable options are available as standard
Interface C with M16 x 2 metric threads
Standard on LBS & VCB (In=630A)

Connection of

- Cable elbow plugs or cable T-plugs with bolted contact M16 for 630 A.
- Paper-insulated mass-impregnated cables via customary adapters.
- Thermoplastic-insulated cables (1-core and 3-core cables).
- Palm type sockets can be bolted on to the bushing conductors.
- Cable testing equipment can be connected after removing the protective cap and/or the end stopper from the cable plug.

Cable Type	Operating Voltage Upto 17.5kv
Heat Shrink Cable	Yes
Reusable Insulating Shrouds	Yes
Touch-Proof Cable	Yes

Cable Compartment

All the cable compartments are with cable termination bushings which are positioned not less than 600mm above gland plate level and are designed for use with inexpensive heat-shrink cable termination kits(the terminals can also accept plug-in elbow).

moulded-in conductors. In addition, a screen is moulded in to control the electrical field and is also used as the main capacitor supplying the voltage indicating systems. The bushings of cable connection are of EN 50181/50180 type (interface C).

All bushings are situated at the same height from the floor and are protected by a cable compartment cover.

The cable box can be duly interlocked with RSW and CB such that cable box can be opened only in EARTH position of RSW and CB. Access to test terminals is achieved by moving the appropriated RSW and CB to EARTH position and opening the interlocked cable compartment cover.

The connection of the HV-cables is made by cable bushings. The bushings are made of cast resin epoxy with



OPTIONAL FEATURES

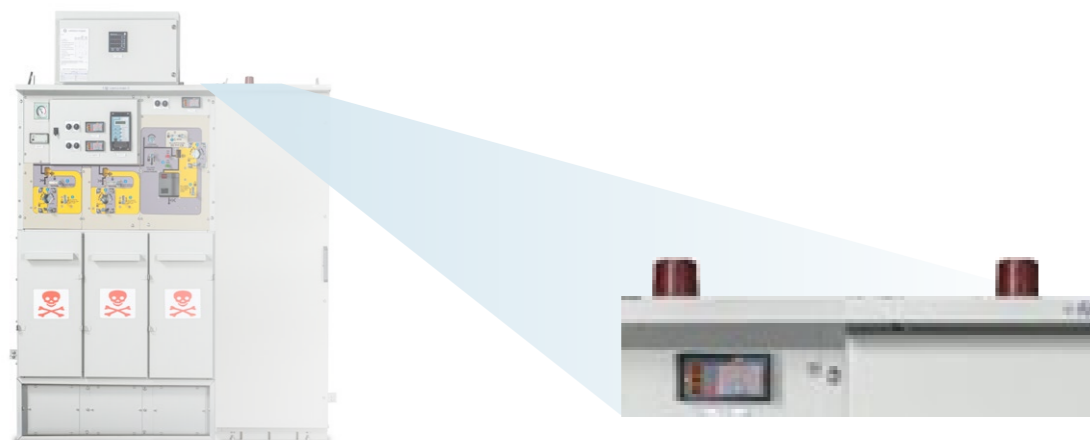


1) Extension

FR1-VI switchgear is possible as an option to have bushings for connection of external busbars on the left and / or right side to satisfy the need of extension in secondary distribution application of RMU. For a FR1-VI switchgear consisting of 1 set of bushings as a provision of extension.

When bushings are mounted on the top, you will have these possibilities:

- Inbuilt bushings for extension in FR1-VI will be prepared for future busbar extension.
- With a coupling kit, it is possible to connect two or more sections. The installation of the coupling busbars has to be done on site with protection covers.
- This extension feature can be used based on need of application at various sites for coupling with other RMU or with metering panel.
- The connection of each functional unit allows for multiple combinations depending on the installation requirements.
- Extension feature of FR1VI does not require any handling of gas.



2) Motorization in RMU(Optional)

To satisfy customer's remote operation need, The manual operated mechanism can be equipped with motor operating feature for Closing and opening operations of load-break switches and charging of the springs of the mechanisms for the circuit breaker.

The disconnecter in the VCB module and all earthing switches do not have this possibility. All motorization equipment are require DC voltage. Retrofitting is also possible if provision for motorization is available.

Auxiliary voltages for motor operating mechanisms

- 24, 48, 60, 110, 220 V DC
- If the control voltage is either 110 or 220 VAC, a rectifier is integrated in the control unit.

Motorized Operations are possible in Local & Remote mode function with LR switch mounted on front of RMU.

3) Remote Tripping & Closing in VCB:

VCB Mechanism can be equipped facility of remote electrical tripping & closing. This possible via tripping & closing coil. These coils is pulse operated, can be controlled by TNC switches locally or remote. This coil can be easily retrofitted or replaced during entire life of RMU.

4) Auxiliary Contacts

Each operating mechanism of the VCB & LBS can be optionally equipped with an auxiliary switch & contacts for the position indication.

LBS function: CLOSED and OPEN: 2 NO + 2 NC

Earthing switch function: CLOSED and OPEN:
1 NO + 1 NC.

VCB Function : 5 NO + 5 NC.

METERING MODULE



Metering module

The metering module is a factory assembled air insulated metal clad cubicle with 12kV suitability. It has IP54 ingress protection for outdoor application. This cubicle is 600mm & 800mm width based on space required for equipment. Metering module can be with options of Bus PTs, Aux PT, Surge arrester in high voltage compartment and scada terminals, Battery-Battery charger & FTRU.

Features in Metering Module based on applications & requirement,

- 1 No of Aux. Potential transformer to generate 230V AC.
- 3 Nos of single pole voltage transformers
- 3 nos of coupling bushings for connecting to RMU
- Battery-Battery charger for 24V DC supply.
- Scada terminals
- Variants with FRTU/Space for FRTU/without FRTU.
- With/without MFM / Energy Meter.



VPIS - / capacitive voltage indicators

In RMU there is need of checking voltage presence in line side /cable side of each module, hence FR1-VI switchgears are equipped with voltage indicators in accordance either with IEC 61958 standard for voltage presence indication Unit (VIU).

VIU indicators indicate only presence of the medium voltage. Absence of the voltage needs to be confirmed by use of voltage detection equipment.

Phase comparison and testing of VIU:

Each phase of the integrated voltage presence indicating system has a connection point on the front panel, which can be used to perform phase comparison and to test the voltage presence indicator.

Phase comparator is used for checking the phase sequence when connecting to different voltages system, e.g during the switching to the alternate power source.





FPI – FAULT PASSAGE INDICATOR

FPI - Fault passage indicator

Short-circuit and earth-fault indicators

Considering demand of automated RMU along with reliability and minimum down time in secondary distribution network requires higher flexibility in formed Ring. FR1-VI is equipped with one of the basic devices is fault passage indicator.

Earth Fault and Short circuit indicator consists of:

- 1 no. Display unit (panel instrument)
- 3 nos. Sensors for detecting Phase Fault along with cable
- 1 no. Sensor for detecting Earth Fault along with cable

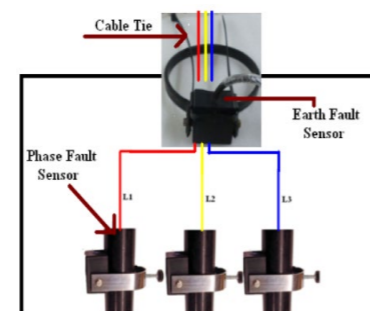


The incorporated lithium battery has a usual life time as follows:

- Standby mode - approx 4 years
- During fault mode with led blinking (Considering 1 fault per month) – approx 3years



FPI is placed in the front panel of the switchgear. It makes it possible to detect any faults, including short circuits & earth-faults, and makes it easier to locate any faulty section. The unit will indicate the fault condition when current is detected present ampere trip current setting. Fault current is sensed by cable mounted sensor, which gives signal to front display unit. All sensors are clamped type and can be retrofitted on the cable.



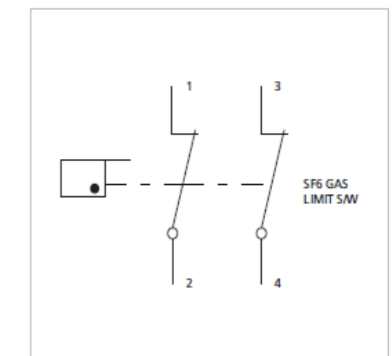
Fault Passage Indicators also be Optional, can be offered in incomer LBS of RMU.



MANOMETER

Manometer / pressure indicator

The RMU tank is sealed with SF6 gas at rated pressure of 0.35bar (relative pressure) @ 20 deg. C, which is continuously monitored by gas pressure indicator. The safe permissible Gas pressure range is between 0.25 to 0.35 bars @ 20 deg. C (Pointer should be within Green Zone as shown in the Figure).



Normally closed switching contact(optional)

Gas Pressure Indicator



- The following optional features are available on request
- The Gas Density Monitor is available with maximum two magnetic snap action switching contacts. These contacts can be normally close (NC) or normally open (NO).
 - These 2 contacts can be used for alarm and tripping purpose. At 0.25 bar the alarm starts & at 0.20 bar tripping occurs
 - Local readout with alarm contacts.
 - Temperature compensated.

Sales Offices - India

Bengaluru

Wework Central, # 36 Infantry road,
Bangalore 560001.

Chennai

Olympia Technology Park 10th Floor, CITIUS A Block,
Plot No.1, Phase 1, Guindy, Chennai - 600032,
Tamil Nadu.

Hyderabad

Schneider Electric India Pvt. Ltd.
Prestige Phoenix, 4th Floor, Near Begumpet
Metro Station, Pillar no. 1408, Uma Nagar, Begumpet,
Hyderabad-500016, Telangana State, INDIA

Kolkata

Electrical Systems & Equipment
L&T Electrical and Automation
A Unit of Schneider Electric India Pvt Limited
2nd Floor, BN3, Salt Lake, Sector V, Kolkata 700091.

Mumbai

Schneider Electric India Private Limited.
L&T Electrical & Automation, 7TH Floor , TC-2,Tower B,
Prima Bay Gate no.5, Saki-Vihar Road,
Powai,Mumbai-400072, India.

New Delhi

A-25,Imperia, First Floor, Mohan Co-operative
Industrial Estate, Mathura Road, Near Sarita Vihar
Metro Station, New Delhi- 110044

Vadodara

Notus IT park, 11th Floor, Block D,
Bhailal Amin Marg, Sarabhai Campus, Vadodara.

Sales Offices - International

India

Schneider Electric India Private Limited.
L&T Electrical & Automation, 7TH Floor , TC-2,Tower B,
Prima Bay Gate no.5, Saki-Vihar Road,
Powai,Mumbai-400072, India.

Kuwait

Kana Controls General Trading & Contracting Co. W.L.L
P.O Box: 25593 Safat, 13116 Kuwait
Tel: +965-2474 1373
Faxes: +965-2474 1537
Email: ese-kwt@Lnitebg.com

Oman

P.O.Box 598, Ruwi, Postal Code-112
Sultanate of Oman
Tel:+968 98034317
Mob:+968 98034317
EMail: ese-oman@Lnitebg.com

Qatar

2 & 3rd Floor, Building No. 209
Zone 42, Street 230, Najma Intersection,
Opp: Doha Cinema, C-Ring Road, P.O Box No- 24399
Doha, Qatar
Tel: +974-44-239 000
Fax: +974-44-551 286
Email: ese-qatar@Lnitebg.com

UAE

2203, 22nd Floor, Green Emirates Tower - A
Electra Street, P.O. Box 52514, Abu Dhabi, UAE
Tel. : +971-2-676 5988
Fax. : +971-2-676 6399
Email: ese-uae@Lnitebg.com



L&T Electrical & Automation, Electrical Systems & Equipment - Head Office

Schneider Electric India Private Limited.

L&T Electrical & Automation, 7TH Floor , TC-2,Tower B, Prima Bay Gate no.5, Saki-Vihar Road,
Powai,Mumbai-400072, India.

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